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British Standards Institution
Report

REPORT No. 82—1919.

British Engineering Standards Association.

(*Incorporated 1918.*)

Formed in 1901 as the Engineering Standards Committee
by
The Institution of Civil Engineers.
The Institution of Mechanical Engineers.
The Institution of Naval Architects.
The Iron and Steel Institute.
The Institution of Electrical Engineers.

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BRITISH STANDARD SPECIFICATION

FOR

STARTERS FOR ELECTRIC MOTORS

(FACE-PLATE TYPE).

(Suitable for Motors not ordinarily requiring to be started more than twice per hour.)

LONDON:
Published for the Association by CROSBY LOCKWOOD & SON,
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British Engineering Standards Association.

(*Incorporated 1918.*)

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BY
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THE INSTITUTION OF MECHANICAL ENGINEERS.
THE INSTITUTION OF NAVAL ARCHITECTS.
THE IRON AND STEEL INSTITUTE.
THE INSTITUTION OF ELECTRICAL ENGINEERS.

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* Succeeded the late SIR JOHN WOLFE BARRY, K.C.B., February, 1918.

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The following are lists of Members of the Sectional Electrical Committee and of the Sub-Committee on Electrical Accessories.

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The Sub-Committee has been assisted in the preparation of this Specification by Mr. A. R. Everest and Mr. C. Rodgers, representing the British Electrical and Allied Manufacturers' Association.

* President, British National Committee. † Hon. Sec. British National Committee.
‡ Also nominated by the Institution of Electrical Engineers.
** Since deceased.

PREFACE.

The drafting of a Specification for Motor Starters was referred by the Sub-Committee on Electrical Accessories to a Panel representative of all interests concerned.

After considerable discussion of certain definite proposals put forward in the first instance by the British Electrical and Allied Manufacturers' Association, a general classification and definitions of the various types of motor starters was agreed upon.

As the ground covered by the complete series of starters was very large, it was decided, in order that the work of this Panel might be available for use as soon as possible, to publish the complete classifications and a separate Specification for each type, the separate Specifications being afterwards combined, if found practicable, in one or more groups.

The first type to be dealt with is the Face-plate Rheostatic Starter, that being the one used in largest numbers at this present time.

This Report was adopted by the Sectional Electrical Committee at their meeting on 10th July, 1918.

This Report was approved on behalf of the Main Committee on 30th December, 1918.

C. H. WORDINGHAM,

Chairman of Sub-Committee
on Electrical Accessories.

Note.—*The Association desires to call attention to the fact that this Specification is intended to include the technical provisions necessary for the supply of the article herein referred to, but does not purport to comprise all the necessary provisions of a Contract.*

BRITISH
STANDARD SPECIFICATION
FOR
STARTERS FOR ELECTRIC MOTORS
(FACE-PLATE TYPE).

(Suitable for Motors not ordinarily requiring to be started more than twice per hour.)

GENERAL CLASSIFICATION AND DEFINITIONS OF MOTOR STARTERS.

Motor Starter.

1. The term " Motor Starter " denotes a device arranged for starting and accelerating a motor to normal speed, but not adapted for use in positions intermediate between the " off " position and the " full-on " position.

The term " Motor Starter " includes—

(*a*) Rheostatic Starters.
(*b*) Compensator Starters.
(*c*) Switch Starters.

Rheostatic Starter.

2. A Rheostatic Starter comprises a resistance and a means for readily varying its amount.

The term " Rheostatic Starter " includes—

(*a*) Face-plate Starters.
(*b*) Drum Starters.
(*c*) Multiple Switch Starters.
(*d*) Contactor Starters.
(*e*) Liquid Starters.

Face-Plate Starter.

3. A Face-Plate Starter is a rheostatic starter in which the contact parts are arranged upon a plane surface.

Drum Starter.

4. A Drum Starter is a rheostatic starter in which the contact parts are arranged upon a cylindrical surface.

Multiple Switch Starter.

5. A Multiple Switch Starter is a rheostatic starter in which each contact consists of a separate hand-operated switch.

Contactor Starter.

6. A Contactor Starter is a rheostatic starter in which each contact consists of a separate contactor.

Liquid Starter.

7. A Liquid Starter is a rheostatic starter in which variable contact is made with a liquid resistance.

Compensator Starter for 2-or 3-phase Alternating Current Motor.

8. A Compensator Starter comprises a compensator (auto-transformer) and a switch, so arranged that when the switch is on the intermediate or starting contact or contacts a reduced pressure is applied to the motor terminals.

Switch Starter for Induction Motor.

9. A Switch Starter is a switch which provides different couplings of the stator windings when in the starting and running positions respectively.

In the case of a 3-phase induction motor, the stator windings are connected to the switch in such a way that when the switch is in the starting position they are connected in star and when in the running position they are connected in delta (mesh); the switch starter is then called a Star-delta Switch.

In the case of a 2-phase induction motor the stator windings are connected to the switch in such a way that when the switch is in the starting position all the windings of each phase are in series, and when in the running position the windings of each phase are in two equal circuits in parallel; the switch starter is then called a Series-parallel Switch.

Renewable Contacts.

10. Renewable Contacts are contacts which, when the starter cover has been removed, can be readily renewed without disturbing any other part of the starter.

FACE-PLATE STARTERS

Applying only to Face-Plate Rheostatic Starters for Direct Current Motors, and for Alternating Current 2- and 3-Phase Induction Motors with Slip Rings, not ordinarily requiring to be started more than twice per hour.

I.

PRESSURES FOR STARTERS.

Rated Pressures for Direct Current Motor Starters.

11. Standard direct current motor starters shall be suitable for use with motors rated for pressures of 110, 220, 440 and 500 volts, and shall be suitable for starting a motor against a torque corresponding to its rated load on pressures differing from these by not more than 10 per cent.

Rated Pressures for 2- and 3-Phase Rotor Starters.

12. Standard alternating current rotor starters shall be suitable for the starting pressures of the rotors with which they are to be used, and shall be suitable for use on pressures differing from those starting pressures by not more than 10 per cent.

It is not considered practicable to standardise pressures for alternating current rotor starters.

II.

TYPES OF ENCLOSURE OF FACE-PLATE STARTERS.

Open.

13. An Open Starter is one in which the front has no protecting cover, whether the resistances are protected or not.

NOTE.—Open Starters are not suitable for use where they are accessible to other than skilled attendants.

Protected.

14. A Protected Starter is one in which the front is provided with a protecting cover having a slot through which the handle projects ; and the resistances have a ventilated protecting cover.

Enclosed Ventilated.

15. An Enclosed Ventilated Starter is one in which the front is totally enclosed : and the resistances have a ventilated protecting cover.

Totally Enclosed.

16. A Totally Enclosed Starter is one in which both the front and the resistances are completely enclosed by protecting covers without openings, so as to prevent access of dust or flyings to the front or the resistances, the starter being operated by an external handle or handwheel on a spindle projecting through the cover.

Drip Proof.

17. A Drip Proof Starter is one having ventilating openings so protected as to exclude falling moisture or dirt.

Weather Proof.

18. A Weather Proof Starter is one in which the front and the resistances have totally enclosing covers as in the Totally Enclosed Type, but with joints so made as to exclude rain or moisture.

Flame Proof.

19. A Flame Proof Starter is not considered a Standard type.

Submersible.

20. A Submersible Starter is not considered a Standard type.

III.

STANDARD SIZES AND CLASSES OF RATING.

Standard Sizes.

21. The following sizes shall be standard :—

¼, ½, 1, 2, 3, 4, 5, 7½, 10, 12½, 15, 20, 25, 30, 35, 40, 45, and 50 Horse Power.

For currents to be assumed for direct current motors *see* Appendix (p. 15).

Classes of Rating.

22. Two Standard Classes of Rating are recognised :—

(*a*) Ordinary Duty.
(*b*) Heavy Duty.

(*a*) An ordinary duty starter is suitable when the working conditions are such that the time required to start the motor from rest to full speed is not longer than that specified in Clause 25, while the limitation of current peaks specified in Clause 27 is complied with.

(*b*) A heavy duty starter is suitable for use on service having more than the usual amount of flywheel effect, such as for punch presses, circular saws, and other tools having heavy flywheels. It is not, however, suitable for more severe services, such as for use with motors driving machines requiring more than 60 seconds to start.

Frequency of Starting.

23. Both the ordinary duty and the heavy duty classes of rating are suitable for use on a service which does not ordinarily involve starting more than twice per hour.

Thermal Capacity of Starters for Ordinary or Heavy Duty.

24. A Standard starter having ventilated resistances (Clause 13, 14, 15 or 17) shall be capable of starting up the motor from rest, under the conditions specified in Clauses 25, 26 and 27, five times in succession without injury, with an interval between successive starts of fifteen times the starting period.

A Standard starter having totally enclosed resistances (Clause 16 or 18) shall be capable of starting up the motor from rest, under the conditions specified in Clauses 25, 26 and 27, three times in succession without injury, with an interval between successive starts of fifteen times the starting period.

Starting Period for test for Ordinary Duty Starters.

25. For the test for Ordinary Duty Starters the starting period of the motor from rest to full speed shall be five seconds plus half a second for each 1 H.P. of the starter rating.

Starting Period for test for Heavy Duty Starters.

26. For the test for Heavy Duty Starters, the starting period of the motor from rest to full speed shall be 60 seconds.

Normal Start for Ordinary Duty and Heavy Duty Starters.

27. The normal start for Ordinary Duty and for Heavy Duty Starters shall be as follows :—

(*a*) The current on the first contact shall not exceed the following values :—

For starters up to and including 7½ H.P., 1½ times full load current.

For starters above 7½ H.P., full load current.

(*b*) The maximum value of the current peaks, when switching from contact to contact, shall not exceed 150 per cent. of the rated full load current for direct current motors.

It is not considered practicable to specify limits for current peak with alternating current motors.

Direct Current Starters.—The values to be assumed for the rated full load current for the purpose of these rules are given in the Appendix.

Alternating Current Starters.—The value of the rated full load current must be ascertained from the motor characteristics.

IV.

CONSTRUCTION.

General Construction.

28. No combustible material shall be used in the construction of the frames, supports or case of the starter.

Joints.

29. All joints between electrical conductors, whether soldered or not, shall have the parts mechanically secured together This clause shall not apply to the contacts between the external conductors and the sockets into which they are soldered.

Renewable Contacts.

30. All contacts, excluding those for the "off" and the "full on" positions, shall be replaceable from the front in the case of starters of the following sizes:—

For a pressure of 110 volts, above 10 H.P.

For pressures from 220 to 500 volts, above 20 H.P.

Direction of Rotation of Handle.

31. For increasing the speed of the motor the handle shall require moving in a clockwise or right-handed direction.

Return of Contact Arm to "Off" Position.

32. A spring, or other means, shall be provided on each direct current starter to prevent any part of the starting resistance being left in circuit.

No-Volt Release.

33. A No-volt Release shall be provided on each direct current starter.

Overload Release.

34. All motor circuits should be protected with independent fuses or overload safety devices. It is not compulsory to provide an overload release as part of a Standard direct current or alternating current starter.

Non-Interruption of Field Circuit.

35. Provision shall be made in the starter to ensure that the field circuit cannot be disconnected from the mains by the operation of the handle without a discharge path.

Circuit Interrupter.

36. Means, independent of the starter, should be provided for breaking the main circuit of the motor and should be used on all ordinary occasions, the starter only returning to the "off" position when released automatically.

Provision for Conduit.

37. Provision shall be made so that if conduit is used it can be securely attached to the case of the starter

Temperature Rise of Release Coils.

38. The maximum permissible temperature rise of release coils as measured by thermometer shall be 50° C.

Size of Terminals for External Connections.

39. All terminals, or sockets if provided, for connections external to the starter shall be suitable for cables of a current-carrying capacity corresponding to the full load current for which the terminal is used in accordance with the Wiring Rules of the Institution of Electrical Engineers. All cable sockets shall be in accordance with the requirements of the British Standard Specification for Cable Sockets (Report No. 91) when such is issued.

Terminal markings.

40. All terminals shall be indelibly marked as follows : —

Direct current Rheostatic Starters.		Alternating Current Rheostatic Starters.	
Terminal for connection to	Mark.	Terminal for connection to	Mark.
Line	L	Line Side	$L_1L_2L_3$
Armature	A	Machine Side 3-phase stator	ABC
Field	F	Machine Side 2-phase stator	$A_0A_1B_0B_1$
Resistance leads (if any)	$R_1R_2R_3$ etc.		

V.

HIGH PRESSURE TESTS.

Application of High Pressure Tests.

41. The high pressure tests given in this Specification shall be applied only to a new and completed starter in normal working condition, with all its parts in place, and, unless otherwise specified, shall be carried out at the starter maker's works. The starter shall have been exposed to the ordinary atmosphere for at least 24 hours prior to the test, and during that interval shall not be artificially dried.

It is generally advisable that the high pressure test shall not be applied when the insulation resistance is less than that indicated in Clause 46.

Table of Test Pressures.

42. A high pressure test in accordance with the following table shall be applied for one minute between earth and the resistances and contacts, the frame of the starter being connected to earth during the test.

The test pressure shall be based on the rated pressure of the starter.

Size of Starters. (See Clause 21.)	Test Pressure (R.M.S.).
Starters below 1 H.P.	500 volts, plus twice rated pressure.
Starters of 1 H.P. and over.	1,000 volts, plus twice rated pressure.

Frequency and Wave Form of Test Pressure.

43. The test pressure shall be alternating, preferably of sine wave form, and of any frequency between 25 and 100 periods per second.

Measurement of Test Pressure.

44. The test pressure shall be measured by means of a suitable instrument connected to the high pressure side of the transformer supplying the test pressure.

Application of High Pressure Test.

45. The test shall be commenced at a pressure about one-third the test pressure given in the table in Clause 42, and shall be increased to the full test pressure as rapidly as is consistent with its value being indicated by the measuring instrument. The full test pressure shall then be maintained for one minute.

Minimum Insulation Resistance.

46. The insulation resistance, when the high pressure test is applied, shall be not less than one megohm.

The insulation resistance shall be measured with a pressure of about 500 volts (direct), applied for a sufficient time for the reading of the indicator to become practically steady.

APPENDIX.

Full load currents to be assumed for direct current motors :—

Size of Motor.	Volts.			
	110	220	440	500
H.P.	amperes.	amperes.	amperes.	amperes.
¼	3·1	1·6	0·8	0·7
½	5·6	2·8	1·4	1·2
1	10·4	5·0	2·6	2·3
2	18	9·0	4·4	3·9
3	26	13	6·0	5·5
4	34	17	9·0	7·5
5	42	21	11·5	9·5
7½	62	31	16	14
10	80	40	20	18
12½	100	50	25	22
15	119	60	30	26
20	155	73	39	34
25	191	96	46	42
30	228	114	57	50
35	264	132	66	58
40	302	151	76	67
45	338	169	85	75
50	375	188	94	83

British Engineering Standards Association.

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JANUARY, 1919.

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